DOCUMENT RESUME

ED 265 758 HE 018 840

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TITLE Graduate Student Survey, 1983-1984 AIP Report.
INSTITUTION American Inst. of Physics, New York, N.Y. Manpower Statistics Div.
REPORT NO AIP-R-207-17
PUB DATE Sep 85
NOTE 14p.
AVAILABLE FROM American Institute of Physics, 335 East 45 St., New York, NY 10017.
PUB TYPE Statistical Data (110) -- Reports - Descriptive (141)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Astronomy; *Degrees (Academic); Doctoral Degrees; *Employment Opportunities; Enrollment Trends; Foreign Students; *Graduate Students; Higher Education; Masters Degrees; Minority Groups; National Surveys; *Physics; Salaries; Specialization; *Student Characteristics

ABSTRACT

Results of the 1983-1984 Graduate Student Survey of physics and astronomy graduates are presented, with attention to: educational background, current graduate student status, choice of subfield, and employment prospects. Highlights include the following: the demand for doctoral physicists remains high, especially in industry; salary increases for new physics graduates range from 5% to 12%; and the number of Orientals increases as the number of Arabs decreases among physics graduate students. Information is included on eight characteristics for the total graduate population, for seven minority groups, and for first-year graduate students, terminal masters, and doctoral recipients: sex, citizenship, whether physics was studied in high school, major of bachelor's degree, type of bachelor's institution, type of graduate institution, full- or part-time attendance, and sources of financial support. Additional tables include: number of advanced graduate physics students specializing in experimental and theoretical subfields by years of graduate study completed; type of employers and work activity of 1983-1984 physics master's and doctoral degree recipients; the number and percent of astronomy graduates students studying selected subfields, and characteristics of the graduate astronomy student population. (SW)

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AIP REPORT - MANPOWER STATISTICS DIVISION

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1983-84

GRADUATE STUDENT SURVEY

by Susanne D. Ellis

September 1985

ED265758

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1983–84 GRADUATE STUDENT SURVEY

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The end of the last decade appears to have witnessed the end of a long decline in graduate physics student enrollment; the trough of the enrollment curve occured in 1979–80 and since then annual enrollment increases of 3% to 5% have been recorded. AIP's annual survey of graduate physics students is designed to call attention to changes in the students' characteristics and focuses on the employment opportunities of graduate degree recipients. In gathering these data we request each graduate student to contribute information on his or her educational background, the current student status, choice of subfield and employment prospects where applicable. The highlights of this report are:

- ⟶ the demand for doctoral physicists remains high, especially in industry
- ⟶ salary increases for new physics graduates range from 5% to 12%
- ⟶ the number of Orientals increases as the number of Arabs decreases among physics graduate students.

One factor that is beginning to influence the demand for new physicists is the growing proportion of foreign graduate students. However, their intentions, and the feasability of their accepting employment in the U.S. are still unclear; hence the monitoring of job offers reported by degree recipients over the years may require a different interpretation from now on. **Figures I** and **II** present five-year trends of employment offers for new doctoral and master's degree recipients and divide the offers into three categories: no offer, one offer and multiple offers. The bar graphs cover the period between 1980 and 1984, and for the doctoral graduates no major changes are indicated. On the other hand, terminal masters, who comprise a smaller group of graduates than the doctors, reported fewer job offers and greater fluctuations since 1980.

Table I presents eight characteristics of the total graduate physics student population as well as those of three subgroups, namely the first-year students, the terminal masters and the doctorate recipients. Our annual Survey of Enrollments and Degrees establishes the total population in each of these groups that form a base for interpreting the responses to the Graduate Student Survey. The first two lines of **Table I** present these numbers.

The proportion of women among the graduate physics students increases very gradually and one needs to go back to the 1970's to identify a significant change. Yet in the most recent year, increases of one percentage-point were recorded for women among "all graduate students" as well as the degree recipients.

The characteristic that has indicated the greatest annual changes in recent years is citizenship. In 1980, 27% of all graduate physics students were foreign citizens and only three years later the corresponding percentage shown in **Table I** is 35%. Most foreign students who come to the U.S. to study physics are interested in a doctorate; which accounts for the comparatively low percentage of foreign students among the terminal masters.

After a three-year absence from the questionnaire, we reintroduced the question concerning high school physics and found

Fig. I. Employment offers for new physics doctorate recipients, 1979–1984.

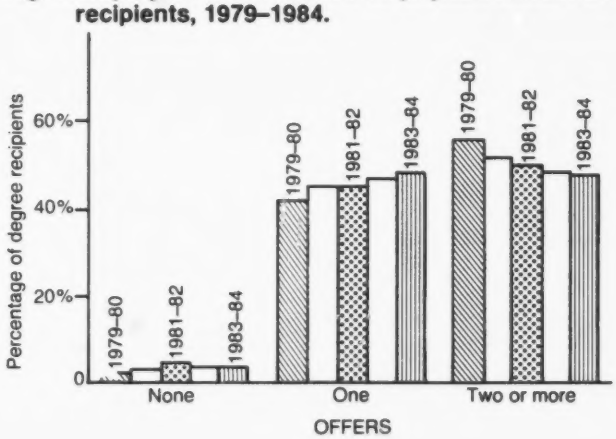

Fig. II. Employment offers for new physics masters, 1979–1984.

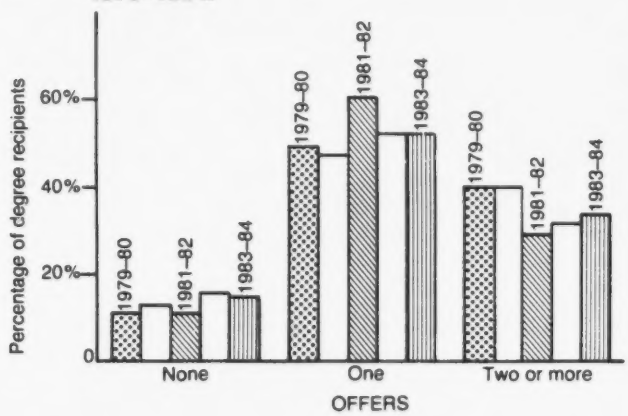

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Table I. Characteristics of the graduate physics student population, 1983–84.

Characteristics		All graduate students	First-year graduate students	Degree recipients: Terminal masters	Degree recipients: Doctorate recipients
	*Total population:	10 922	2855	657	971
	Number of respondents	6 401	1337	257	542
Sex	Female	12%	12%	14%	8%
	Male	88	88	86	92
Citizenship	U.S.	65%	62%	80%	75%
	Foreign	35	38	20	25
Physics in high school	Yes	93%	90%	91%	95%
	No	7	10	9	5
Major of bachelor's degree	Physics	88%	82%	85%	93%
	Mathematics	3	3	4	2
	Engineering	5	7	6	2
	Other	4	8	5	3
Type of bachelor's institution	PhD-granting	45%	38%	44%	52%
	MS-granting	7	9	14	5
	BS/BA-granting	17	18	24	19
	Foreign	31	35	18	24
*Type of graduate institution	PhD-granting	91%	85%	78%	100%
	Ms-granting	9	15	22	–
*Student status	Full-time	90%	83%	75%	92%
	Part-time	10	17	25	8
Source of support	Teaching assist.	36%	52%	46%	14%
	Research assist.	41	13	17	61
	Fellowship	8	9	5	9
	Employment (part-time)	3	4	6	3
	Family, savings, loan	3	4	7	3
	Other**	9	18	19	10

* These data were derived from the Survey of Enrollments and Degrees. ** Includes full-time employment for part-time students.

that there was little change in the proportions of graduate physics students who had no exposure to physics before entering college.

Traditionally physics is not a discipline that attracts many students from other undergraduate majors into physics graduate study; however, the 1983–84 first-year students include a greater proportion (18% compared with 13%) of nonphysics majors than in prior years. But looking at the doctorate recipients in **Table I**, we note that only 7% of them had transferred to physics as graduate students.

Other characteristics, such as the types of institutions attended, and the sources of support show little change from earlier years. However, the student status of first-year graduate students indicates a significant increase in part-time students; an increase from 11% to 17% in one year.

The total number of survey respondents who identify themselves as members of a specific minority group is close to 1900 or almost 30% of all respondents. **Table II** lists the minority groups and divides only the larger ones on the basis of citizenship; Asian Indians and Arabs are predominantly foreign so that foreign students among all minority groups combined, comprise 90%. In addition to citizenship, **Table II** lists six characteristics and the two bottom rows of the table indicate the number of degree recipients in each minority group for the academic year 1983–84. These numbers should be treated as lower limits because they represent individual respondents to a survey whose overall response is less than 60%. Black degree recipients are the exception because physics department chairpersons are asked to report the numbers of black graduates as part of the Survey of Enrollments and Degrees, thereby improving the accuracy of those totals. However, there is no second source for the enrollment data on blacks and since 1980–81, when 70 U.S. black graduate students responded to this survey, their numbers of respondents declined steadily to 39 shown in **Table II**. On the other hand, the enrollment of foreign Orientals has increased steadily since 1978–79, when 531 graduate students responded to this survey.

When comparing the characteristics of the minority groups with those of all graduate physics students we find that the minority groups include proportionately more women, more students who took physics in high school, and more full-time students.

The data in **Table III** were scaled up to give an estimate of the total number of graduate physics students in each of the major subfields and at nine levels of graduate study. One reason for presenting this type of analysis is to make it possible to estimate the number of graduates in a given subfield who will

Table II. Characteristics of minority group physics students, 1983–84.

Characteristics		Black U.S.	Black Foreign	American Indian	Hispanic Puerto Rican	Hispanic Mexican American	Other U.S.	Other Foreign	Asian Indian	Oriental U.S.	Oriental Foreign	Arab
	Total number:	39	29	12	23	13	9	155	357	97	957	193
Sex	Female	6	2	2	5	1	1	18	76	16	135	22
	Male	33	27	10	18	12	8	137	281	81	824	171
Candidacy for:	TMS	5	5	3	2	1	1	14	22	12	38	14
	MS and PhD	28	22	8	13	7	4	98	299	63	601	156
	PhD only	6	2	1	8	5	4	43	36	22	318	23
Student status	Full-time	30	27	9	20	11	8	153	345	88	921	184
	Part-time	9	2	3	3	2	1	2	12	9	36	9
Physics in high school	Yes	31	25	10	19	9	8	151	347	90	932	186
	No	8	4	2	4	4	1	4	10	7	25	7
Full-time equivalent years of graduate study	<1	7	5	3	8	4	1	20	62	28	205	33
	2	3	12	–	–	5	2	34	62	22	242	35
	3	13	6	4	4	–	2	40	70	8	175	32
	4	4	4	1	3	1	2	19	51	12	136	25
	5	5	1	3	2	2	–	26	58	8	92	16
	>6	7	1	1	6	1	2	16	54	19	107	52
Major subfields	Elect. at. mol.	1	2	2	–	4	–	11	26	4	81	15
	Elem. particles	5	–	2	2	1	3	18	38	11	81	17
	Math. physics	2	1	–	2	–	2	29	29	8	54	14
	Nuclear	2	3	2	1	1	1	11	29	4	55	32
	Plasma/fluid	1	–	–	–	1	1	7	7	6	43	7
	Solid state	15	12	2	8	5	–	46	132	34	438	55
Graduate degree recipients	TMS	4	2	–	–	1	1	7	18	5	21	11
	Doctorates	8	2	3	3	2	1	18	41	15	81	29

seek employment within a year or two. The median number of years of graduate study spent to complete a physics doctorate is between five and six. Another function of **Table III** is that it indicates which subfields are likely to require more time to complete a dissertation; electron, atomic or molecular physics appears to be an example of such a specialty. In comparison with the previous year, the distribution of graduate students among the subfields has changed little, with the exception of mathematical physics which shows a moderate increase — probably attributable to the increase in foreign students.

Table III. Number of graduate physics students, by subfield and years of graduate study completed, 1983–84.

		Full-time equivalent years of graduate study									Total graduate students	
		1 yr.	2 yrs.	3 yrs.	4 yrs.	5 yrs	6 yrs.	7 yrs.	8 yrs.	>9 yrs.	N	%
Distribution* of students	N	2855	2270	1703	1420	1146	732	415	240	141	10922**	
	%	26.1	20.8	15.6	13.0	10.5	6.7	3.8	2.2	1.3		100%
Astrophysics		136	96	63	77	60	29	27	14	–	502	4.6
Bio/medical physics		77	69	55	38	35	22	11	7	3	317	2.9
Electron, atomic, molecular		191	170	162	111	113	52	43	19	35	896	8.2
Elem. particles		330	283	204	182	139	97	71	36	12	1354	12.4
Geo/atmospheric physics		85	93	62	43	39	40	11	7	2	382	3.5
Mathematical physics		245	182	144	116	94	48	22	21	2	874	8.0
Nuclear physics		196	163	150	145	110	75	41	10	17	907	8.3
Optics		180	134	61	60	36	30	22	10	2	535	4.9
Plasma/fluid physics		123	105	88	98	50	38	17	17	10	546	5.0
Solid state		822	733	592	473	388	263	134	83	51	3539	32.4
Engineering/applied		171	102	37	31	26	14	6	3	3	393	3.6
Other subfields		299	140	85	46	56	24	10	13	4	677	6.2

* The distribution of students in each subfield is based on 6401 respondents to this question.
** The total was derived from the Survey of Enrollments and Degrees.

Table IV. Sources of support for graduate physics students, by sex and degree status, 1983–84.

Source of support		Female	Male	Candidates for: Terminal master's	Master's enroute to PhD	PhD after master's	PhD only	Total N	Total %
Teaching assistantship		39%	32%	41%	47%	25%	30%	2112	33
Research assistantship		36	42	13	26	52	47	2654	41
Fellowship		7	8	4	7	8	11	518	8
Foreign government		3	2	2	2	2	2	126	2
Family, savings, loan		4	3	7	4	3	2	192	3
Part-time employment		2	3	8	3	3	1	184	3
Other, including multiple Sources of support		9	10	25*	11	7	7	615	10
		100%	100%	100%	100%	100%	100%		
Total respondents	N	747	5654	640	1280	2751	1730	6401	
	%	12	88	10	20	43	27		100%

* Includes masters who worked full-time to support their graduate studies.

The sources of support for graduate students are determined by the students' candidacies for specific degrees as well as the years of graduate study completed. First and second year students are more likely to be offered teaching assistantships whereas research assistantships are more prevalent among the advanced students. Since more women are terminal master's rather than doctoral candidates, **Table IV** shows that a greater proportion of women than men hold teaching assistantships.

The recent dramatic increase in foreign physics students prompted us to add a new source of support to those listed on the questionnaire, namely "foreign government." 1983–84 was the second year for that additional listing and in both years only 2% of the graduate students received financial support from their native countries. If that proportion remains small it may indicate that few foreign graduates are committed to return to their native countries for employment.

Table V. Number* of advanced graduate physics students specializing in selected experimental or theoretical subfields by years of graduate study completed, 1983–84.

Physics subfield	Type of research	Full-time equivalent years of graduate study. 3 yrs.	4 yrs.	5 yrs.	6 yrs.	7 yrs.	8 yrs.	>9 yrs.	Total N	% Exp.	% Theo.
Astrophysics	experimental	45	45	36	20	18	8	–	172	4.3	
	theoretical	19	32	25	10	10	5	–	101		5.6
Bio/medical	experimental	45	33	27	17	12	5	1	140	3.5	
Electron, atomic molecular	experimental	125	83	89	52	32	16	27	424	10.6	
	theoretical	32	17	25	2	12	2	5	95		5.3
Elem. particles	experimental	103	120	82	77	61	27	6	476	11.9	
	theoretical	98	61	60	24	5	1	5	254		14.1
Math. physics	theoretical	145	120	83	43	22	21	2	436		24.2
Nuclear	experimental	109	102	88	60	31	9	13	412	10.3	
	theoretical	29	43	22	12	12	–	3	121		6.7
Optics	experimental	57	54	29	22	21	8	1	192	4.8	
Plasmas	experimental	49	53	20	27	9	9	5	172	4.3	
	theoretical	46	42	33	12	6	8	2	149		8.3
Solid State	experimental	438	339	298	235	117	69	37	1533	38.4	
	theoretical	141	131	93	36	19	9	10	439		24.4
Other subfields	experimental	155	104	91	55	18	35	17	475	11.9	
	theoretical	67	41	45	28	10	8	7	206		11.4
Total	experimental	1126	933	760	565	319	186	107	3996	100.0%	
	theoretical	577	487	386	167	96	54	34	1801		100.0%

* The numbers in this table have been scaled up to reflect the total number of graduate students (5797) who completed three or more years of graduate study.

Table VI. Distribution by subfield and employment offers for doctorate recipients, 1983–84.

Physics subfield		Total in subfield	Employment-oriented graduates	New 'postdocs'	Percentage of graduates within subfield received: 0 offer	1 offer	>2 offers
Astrophysics		4.5%	1.3%	3.2%	–	72%	28%
Bio/medical physics		3.4	1.4	2.0	–	64	36
Electron, atomic molecular		10.2	5.4	4.8	9%	36	55
Elem. particles		13.2	4.6	8.6	3	52	45
Math. physics		6.2	2.6	3.6	3	45	52
Nuclear		8.0	4.2	3.8	2	47	51
Optics		3.9	3.1	0.8	10	35	55
Plasmas, fluids		5.3	3.5	1.8	8	56	36
Solid state		34.7	18.3	16.4	4	47	49
All other subfields		10.6	7.3	3.3	5	46	49
Total	%	100.0%	51.7%	48.3%	4%	48%	48%
	N	958*	489	469			
All experimental subfields			380	313	4%	47%	49%
All theoretical subfields			109	156	5%	49%	46%

* This total does not include an estimated 13 graduates who were not interested in immediate employment, (see Figure IV). It is the Survey of Enrollments and Degrees which supplied this total.

The normal pattern of graduate education in physics consists of two years of course work followed by three or four years of research in an area of concentration which leads to a doctoral dissertation. The intensive professional work, which usually starts in the third year of graduate school, is performed either on an experimental or theoretical basis. An array of doctoral candidates, grouped by type of research, subfield and level of graduate study, is presented in **Table V**. The ratio of experimentalists to theoreticians is approximately 2:1 and compared with the previous year, mathematical physics reflects an increase while elementary particles decreased a little.

DEGREE RECIPIENTS

The degree of specialization achieved by doctoral graduates is closely linked with the requirements of employers. Consequently, employment opportunities for new physicists are expressed in terms of physics subfields as well as types of research. Furthermore, for each subfield, **Table VI** distinguishes between doctorate recipients who sought potentially permanent positions and those who accepted postdoctoral fellowships. The latter group generally includes 4% or 5% whose postdoctoral fellowships were offered by employers outside the U.S.

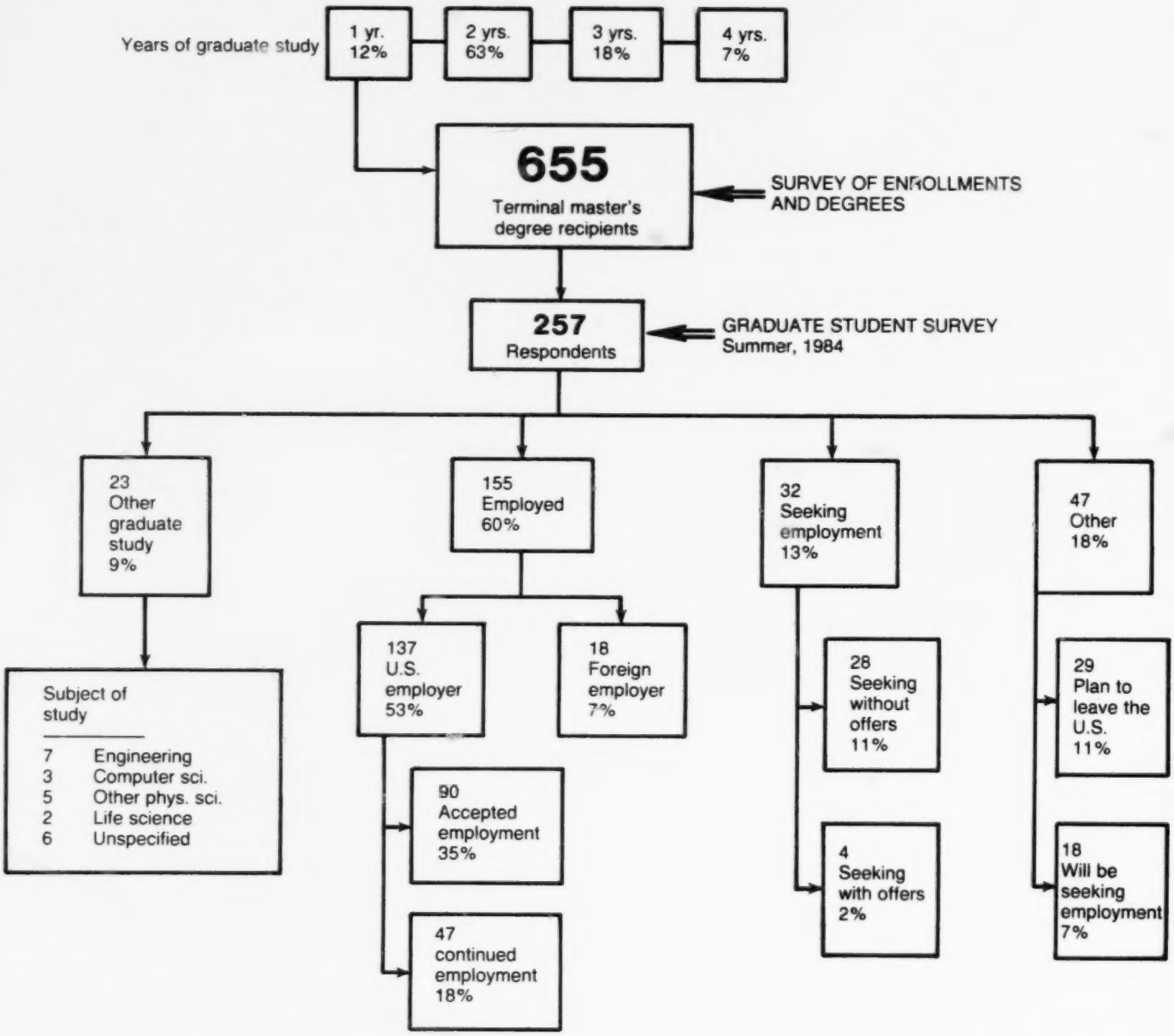
The number of employment offers reported by the graduates has not changed significantly in recent years, although the category "no offer" in certain subfields appears to fluctuate. For example, all the responding medical physicists in the class of 1984 had at least one job offer, a change from the previous year when 15% were without immediate employment offers. However, the number of respondents in a specific subfield usually ranges between 10 and 30, causing the percentages to fluctuate.

The analysis presented in **Table VII** is designed to focus on the international aspects of employing physicists. Not only do many foreign graduates remain in the U.S. for their initial employment, but some U.S. citizens go abroad to accept their first postdoctoral positions. To monitor the extent to which such an exchange occurs annually, we have included an analysis of the type shown in **Table VII** of this report. There were 132 foreign doctorate recipients among the respondents shown in **Table VII**, and 76% of them remained in the U.S. Going back to the Class of 1980, we find that only 61% of the foreign doctoral graduates remained in the U.S., and the early 1980's indicated a gradual increase in that percentage. In 1980, these foreign graduates were divided equally between postdoctoral and potentially permanent offers from U.S. employers, whereas in 1984 those offers were made in a ratio of almost 3:1.

Table VII. Employment of doctoral graduates by citizenship, 1983–84.

Doctoral graduates		U.S. employer 'Postdoc'	U.S. employer Accepted	U.S. employer Cont.	Foreign employer 'Postdoc'	Foreign employer Accepted	Uncommitted	Total N	Total %
U.S. citizens		166	164	36	17	4	16	403	75
Foreign citizens		74	23	3	5	22	5	132	25
Total	N	240	187	39	22	26	21	535	
	%	45	35	7	4	5	4		100%

Figure III. Post-degree plans of physics terminal master's degree recipients, 1983–84.



By terminating graduate study in physics at the master's level, the student has the option of either continuing graduate work in another discipline, or starting employment; **Figure III** shows that almost three-quarters of the class of 1984 fell into the latter category. As indicated in **Table I**, 25% of the terminal masters completed their degrees on a part-time basis, which is supported by the data in the top row of **Figure III**.

Fewer than 10% of the masters change disciplines as they continue their graduate studies, often in an area closely related to physics. The largest single group among those graduate students continues to be the one which transfers to engineering.

Table VIII. Distribution, by subfield, of employment offers for terminal masters, 1983–84.

Physics subfield	Total in subfield*	Percentage of graduates within subfield received: 0 offer	1 offer	≥2 offers
Electron, atomic, molecular	7.3%	15%	46%	39%
Engr. and applied physics	12.1	13	65	22
Geo. space physics	4.0	–	88	12
Nuclear	7.7	44	13	43
Optics	10.9	21	67	12
Plasma/fluids	4.0	28	57	15
Solid state	27.0	16	48	36
General physics	9.3	25	60	15
All other subfields	17.7	18	61	21
Total	100.0%	15%	52%	33%
Employment-oriented respondents	187	28	98	61

Based on 257 respondents.

As the number of foreign citizens among the terminal masters increases, more graduates are uncertain of their plans because they look into the possibility of changing their student visas to those with which they can accept employment in the U.S. **Figure III** includes these students under "other", which consists of graduates who plan to leave the U.S. as well as those who postpone their search for employment.

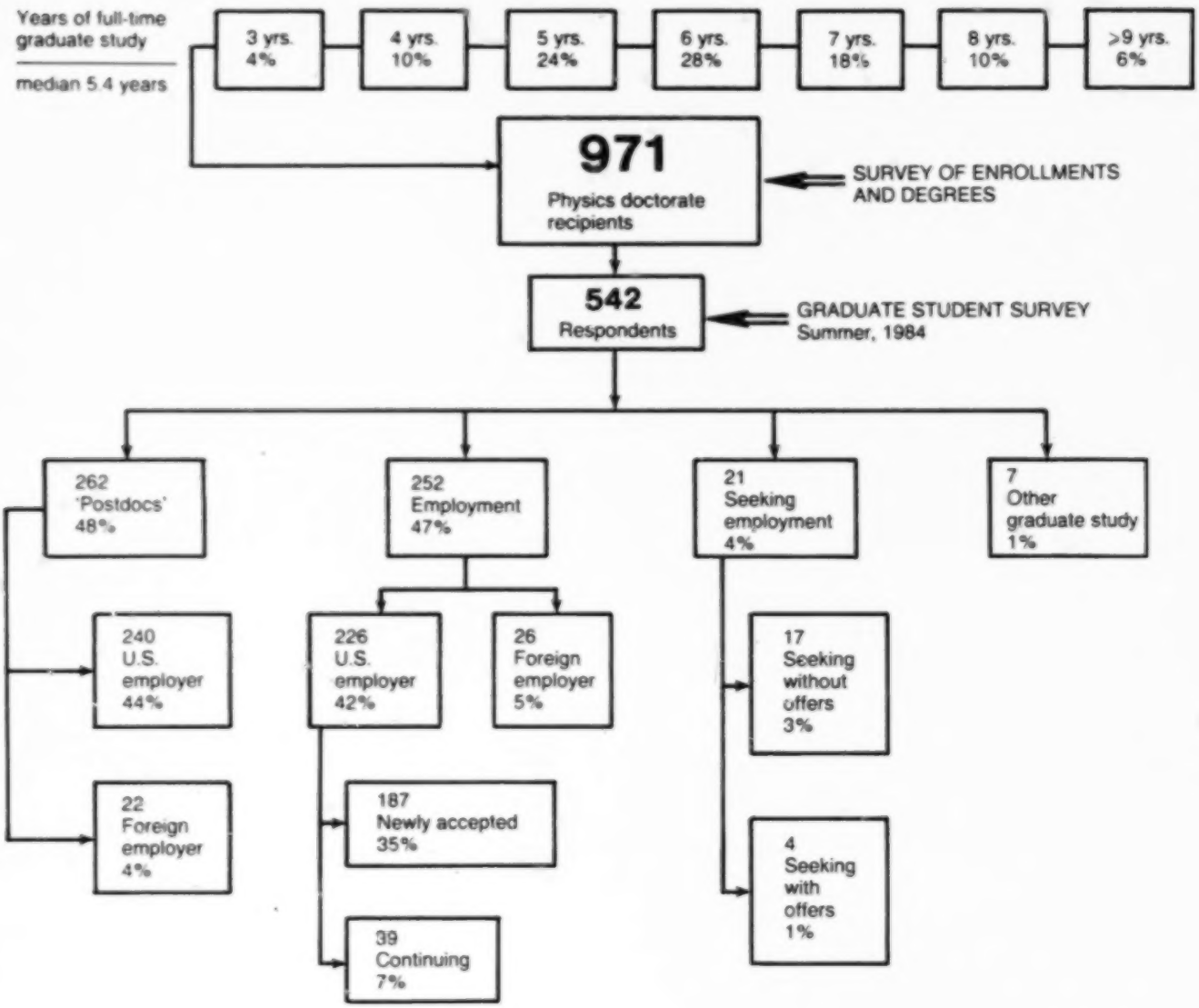
To offer greater detail on the masters with immediate employment plans, we constructed **Table VIII** which relates employment offers to the graduates' areas of concentration. Offers as well as acceptances involving foreign employers are included in this table. The percentage of job-seekers who had no immediate offers dropped slightly, while one-third of the graduates again reported multiple offers to choose from.

Although the survey from which these data are derived is conducted in the summer, most of the new graduates were able to specify not only the type of employer but also their work activities and **Table IX** presents this information. As in past years industry remains the largest single employer of new masters. Secondary schools attracted only three more graduates than in the previous year, and ten new masters accepted positions requiring a graduate education without utilizing their physics training; their work activities were categorized as "nonphysics professional" work.

Table IX. Employment characteristics of 1983–84 recipients of master's degrees.

Work activity		Type of employer: Sec. school	Coll.	Univ.	Industry	Gov't inc. mil.	FFRC	Total N	Total %
Teaching		10	5	6	1	5	–	27	17
Teaching & Res.		–	2	6	7	1	3	19	12
Res. and dev.		–	–	2	34	11	1	48	31
Engineering		–	–	1	34	5	2	42	27
Comp. science		–	–	2	6	2	1	11	7
Nonphysics professional		–	–	1	5	3	1	10	6
Total	N	10	7	18	87	27	8	157	
	%	6	5	12	55	17	5		100%

Figure IV. Background characteristics and post-doctorate status of 1983–84 physics graduates.



The flow diagram of **Figure IV** presents an overall picture of the physics doctorate recipients for 1983–84. In view of the increasing proportion of foreign graduate students we expected the time scale to change; however, a comparison of the distribution shown in the top row of **Figure IV** with that of prior years indicates small increases at both ends of the scale. In particular, more physicists in the class of 1984 required less than five years or more than seven years to complete their doctorates. The major change in post-degree status concerns the 'postdocs'. The fact that 44% of the new physicists accepted 'postdocs' in the U.S. represents a five percentage-point increase over the previous year. At the same time more newly accepted permanent positions from U.S. employers were reported and the proportion of graduates without immediate offers decreased slightly, all of which contributes to a favorable employment picture where new physicists are concerned.

Table X. Use of physics in potentially permanent employment of graduate degree recipients, 1983–84.

	Major employer	Extensive use of physics training with respect to: method	subject matter	Number responding to question
Doctorate recipients	University	97%	97%	33
	Industry	72	54	105
	FFRC	78	83	18
	Government	94	100	18
	Total	78%	71%	191

		Use of physics training with respect to subject matter			
		Extensive	Little	None	Number reporting
Terminal masters	Educational inst.	83%	17%	–	18
	Industry	45	45	10%	71
	FFRC/Gov't.	68	29	3	28
	Total	56%	37%	7%	118

A closer examination of the initial employment reveals the extent to which new graduates utilize their physics training. **Table X** summarizes the responses from both doctoral and master's graduates who had accepted potentially permanent positions. Without taking specific employers into consideration a greater proportion of doctoral physicists makes extensive use of the research methods they were taught than of the subject matter of their subfields. But this need not be true for individual employers.

Few masters have had the time in graduate school to develop research methods: consequently it is more meaningful to examine the extent to which an employer utilizes the subject matter of a new master's level physicist. As expected, educational institutions rank highest among employers who make extensive use of the graduate's physics training, while in industry little or no use of physics training was reported by half of the respondents.

To examine further the concern about underemployment, we focus on the work activities of doctorate recipients who accepted potentially permanent positions. **Table XI** lists the traditional work activities along with engineering and relates them to the major employers. Thus we find that between 1983 and 1984 a shift occurred from teaching and/or research toward research and development as industry attracts an increasing proportion of new doctoral physicists.

Table XI. Initial employment with potential permanence for 1983–84 physics doctorate recipients.

Work activity		Type of employer: University Tenurable	University Non-tenurable	Coll.	Industry	FFRC	Gov't.	Nonprof. org.	Total N	Total %
Teaching		6	4	9	–	–	1	–	20	9
Research		1	7	–	19	9	8	3	47	22
Res. and teaching		13	6	4	–	–	–	–	23	10
Res. and dev.		2	3	–	68	8	11	1	93	43
Engineering		–	–	–	20	–	–	–	20	9
Other		1	2	–	10	1	1	–	15	7
Total	N	23	22	13	117	18	21	4	218*	
	%	10	10	6	54	8	10	2		100%

* Of the 252 doctorate recipients (see Figure IV) 34 did not specify both work activity and type of employer.

Table XII. Median monthly starting salaries paid by U.S. employers to new physics degree recipients, 1984

Type of Employer	Bachelor's degree recipients: Percentage accepting positions	Bachelor's degree recipients: Monthly starting salaries	Terminal master's degree recipients: Percentage accepting positions	Terminal master's degree recipients: Monthly starting salaries	Doctorate recipients: Percentage accepting: 'Postdocs'	Doctorate recipients: Percentage accepting: Potentially perm. pos.	Doctorate recipients: Monthly starting sal. for: 'Postdocs'	Doctorate recipients: Monthly starting sal. for: Potentially perm. pos.
Secondary school	4%	$1100	7%	$1560	–	–	–	–
College	2	1230	4	1750	–	3%	–	$2050
University	3	1230	13	1450	34%	10	$1675	2210
Industry	54	2120	53	2550	3	26	2750	3160
Gov't inc. mil.	34	1560	17	2100	4	5	2120	2590
Fed. Funded Res. Ctr.	2	2120	5	2225	9	4	2030	3090
Other	1	1250	1	–	1	1	2050	3050
All employers	100%	$1870	100%	$2360	100%		$1790	$3020

Starting salaries presented in **Table XII** include only those paid by U.S. employers for newly accepted positions. Hence the 39 physicists shown in **Figure IV** as "continuing" the employment they held while completing their doctorates, are not included. Doctoral physicists are divided into two groups because those starting potentially permanent employment are paid significantly higher salaries than those who accepted postdoctoral fellowships. For purposes of comparison, the starting salaries of physics bachelors were included in **Table XII** although they are not collected as part of the Graduate Student Survey. Thus the four salaries shown for the three levels of physics degree recipients continue to place 'postdocs' and regularly employed doctoral physicists at opposite ends of the salary scale. Their 1984 starting salaries correspond to 8% and 9% increases respectively. The salaries of physics masters registered a 5% increase over the previous year, and bachelors recorded the largest increase, 12%. Industry not only pays the highest salaries of all the employers, but also recorded the largest increase in the proportion of new doctoral physicists from the class of 1984; the 26% shown in **Table XII** represents an increase from 21% in the previous year.

ASTRONOMY

Since a majority of the graduate astronomy students starts out by studying physics, a comparison with the graduate physics students appears inevitable. However, the graduate astronomy population is enrolled in only 46 institutions in the U.S. and comprises less than 10% of the graduate physics enrollment.

Table XIII. Graduate astronomy students* by subfield and years of graduate study, 1983–84.

	Full-time equivalent years of graduate study: 1 yr.	2 yrs.	3 yrs.	4. yrs.	5 yrs.	>6 yrs.	Total: N	Total: %
Distribution of students N	154	137	103	110	89	95	688	
Distribution of students %	22%	20%	15%	16%	13%	14%		100%
Astronomy subfields								
Astronomical instruments and techniques	4%	2%	6%	4%	5%	8%	32	5%
Cosmology, extragalactic objects, quasi-stellar objects	19	15	21	32	27	23	150	22
Galactic structure, stellar motions	4	5	11	1	7	6	37	5
Interstellar matter and gaseous nebulae	15	23	9	13	16	14	105	15
Solar system, space astronomy of the solar system	10	8	6	10	5	17	65	9
Stellar atmospheres and spectra, stellar evolution, solar and stellar interiors	17	10	18	13	14	17	101	15
Supernovae, X, γ, and cosmic rays, pulsars	2	4	12	4	4	6	36	5
The sun	1	4	5	6	7	1	26	4
Astrophysics	15	13	5	4	12	4	62	9
All other subfields combined	13	16	7	13	3	4	74	11
	100%	100%	100%	100%	100%	100%		100%

* The percentages shown in this table are based on 461 respondents to the Graduate Student Survey. Astronomy department chairpersons reported a total of 688 graduate students for the Survey of Enrollments and Degrees.

Compared with the graduate physics students, the astronomy students are better respondents to our survey and in 1983–84 two-thirds of the 688 graduate students contributed their information to this survey. Among the questions they answered were level of graduate study and subfield. **Table XIII** relates these two variables and includes astrophysics which is also listed among the physics subfields. By far the largest subfield is cosmology, followed by interstellar matter and stellar atmospheres. The distribution of students among nine major subfields listed in **Table XIII** has remained relatively stable in recent years.

The format of **Table XIV** is similar to that of **Table I** because it too focuses on characteristics of graduate students. However, only two subgroups of all astronomy graduate students are presented in this table because too few masters responded out of a possible 22 such degree recipients.

Traditionally, astronomy has always attracted a larger proportion of women and fewer foreign students; 1983–84 is no exception. The reason why a majority of astronomers began their careers by majoring in physics, is that only about 60 institutions in the U.S. offer an astronomy program which leads to a bachelor's degree.

Examining the choices of undergraduate institutions, we note that astronomers, even more so than physicists, chose PhD-granting universities for their undergraduate education. And in regard to support, it may be worth noting that 98% of the first-year graduate students study full-time and are supported by means other than employment.

Table XIV. Characteristics of the graduate astronomy student population, 1983–84.

Characteristics		All graduate students	First-year graduate students	Doctorate recipients
	*Total population:	688	154	74
	Number of respondents:	461	90	54
Sex	Female	16%	22%	16%
	Male	84	78	84
Citizenship	U.S.	78%	72%	83%
	Foreign	22	28	17
High school physics	Yes	94%	91%	96%
	No	6	9	4
Major of bachelor's degree	Astronomy	33%	31%	37%
	Physics	57	60	52
	Mathematics	2	1	8
	Other	8	8	3
*Type of bachelor's institution	PhD-granting	62%	60%	69%
	MS-granting	4	2	2
	BS/BA-granting	16	16	14
	Foreign	18	22	15
Type of graduate	PhD-granting	95%	91%	100%
	MS-granting	5	9	–
*Student status	Full-time	96%	98%	89%
	Part-time	4	2	11
Source of support	Teaching assist.	27%	50%	9%
	Research assist.	44	16	58
	Fellowship	16	26	14
	Employment	3	2	4
	Other	10	6	15
Major subfields	Cosmology	22%	18%	30%
	Interstellar matter	15	15	12
	Solar system	9	10	15
	Stellar atmos. & spectra	15	17	13
	Astrophysics	9	15	5

* These data were reported by astronomy department chairpersons as part of the Survey of Enrollments and Degrees.

Note: Only 22 terminal master's degrees were granted and 16 responses received.

Figure V. Background characteristics and post-doctorate status of 1983–84 astronomy graduates

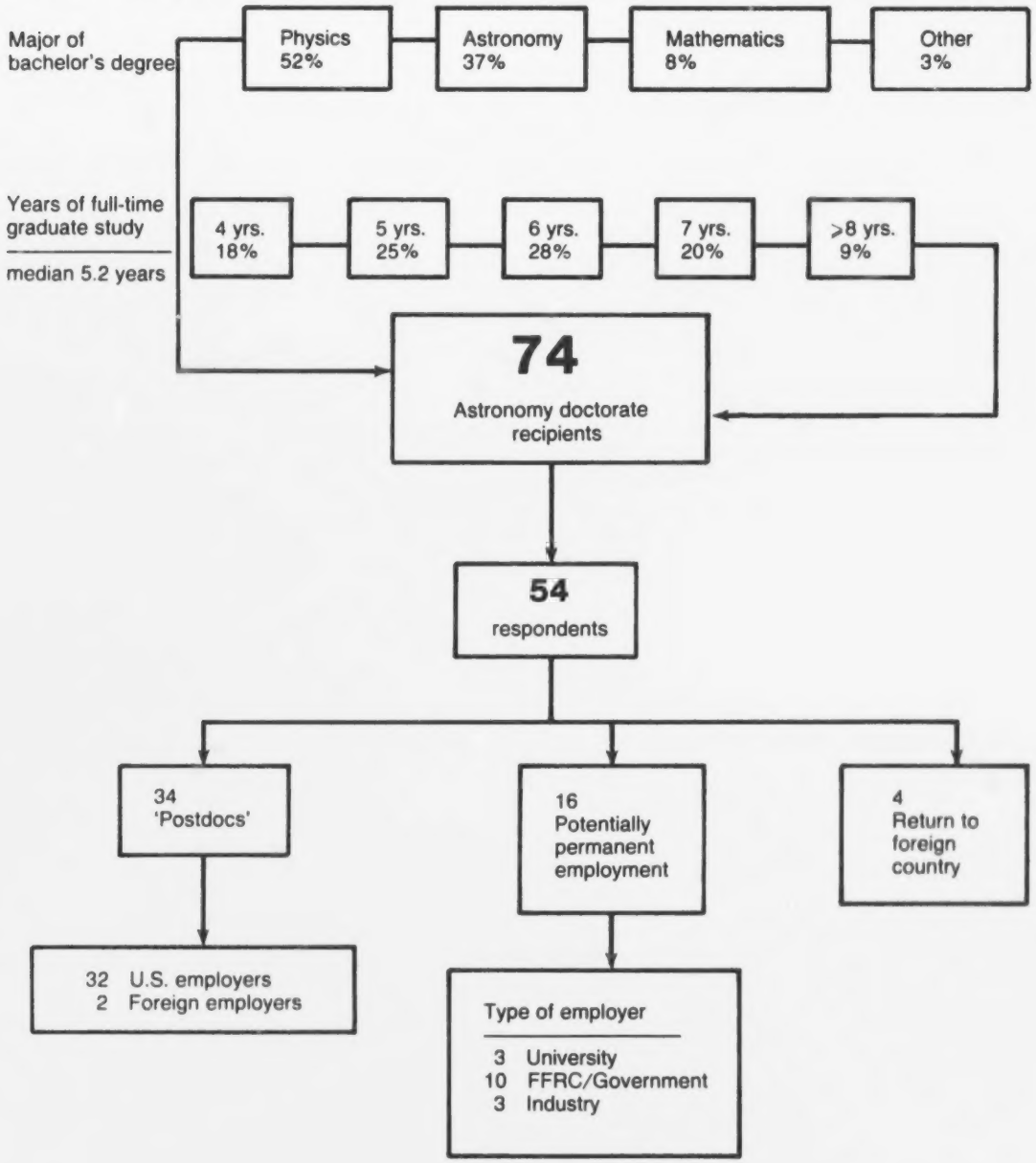


Figure V adds to the characteristics of new doctoral astronomers shown in **Table XIV**, by presenting their post-doctorate employment status. As in past years, a majority of the graduates accepted 'postdocs', and unlike the new physicists, all of the doctorate recipients reported some form of commitment at the time of this survey.